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Treatment of Infective Conjunctivitis with Ayurvedic Eye Drops: A Single-Blind, Randomized, Clinical Trial with Levofloxacin Ophthalmic Solution as Control

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ABSTRACT

Objective: To evaluate the efficacy of *Nimbadi* eye drops on symptoms and signs of Infective Conjunctivitis (*Netrabhishyanda*) as compared to Levofloxacin 0.5% ophthalmic solution. **Methods:** This was a prospective, single-blind, randomized, and drug-controlled clinical trial. Sixty eyes of thirty patients, diagnosed with infective conjunctivitis, were randomized into two groups of fifteen patients (30 eyes) each to receive either *Nimbadi* eye drops or Levofloxacin (0.5%) ophthalmic solution in a dose of 2 drops 4 times a day for 10 days. Symptoms and signs of conjunctivitis were graded according to severity of the disease. **Results:** The effects of the Trial drug on Bulbar conjunctival injection, Palpebral conjunctival injection, Subconjunctival haemorrhage, Watering, Foreign body sensation, Grittiness, and Pain were equal to and statistically similar to that of the effect of the control drug. Conjunctival discharge, Burning sensation, Itching, Ocular discomfort, and Photophobia were better controlled by the Trial drug during the whole course of the disease as compared to the Control drug. There were no adverse effects of the Trial drug (*Nimbadi* eye drops) observed. **Conclusions:** *Nimbadi* eye drops is effective in treating *Netrabhishyanda* (Infective Conjunctivitis)

Keywords: Abhishyanda, Netrabhishyanda, infective conjunctivitis, Azadirachta indica, Symplocos racemosa.

INTRODUCTION

Infective conjunctivitis poses a widespread challenge globally, affecting individuals of all ages and genders [1]. Typically stemming from bacterial or viral origins, bacterial infections tend to prevail among children, while viral infections are more common in adults. The clinical presentation of infective conjunctivitis shares resemblances with a range of ocular ailments outlined in Ayurveda as *Netrabhishyanda* (or simply *abhishyanda*), particularly those associated with *Pitta* and *Rakta* imbalances [2]. Although infective conjunctivitis is often self-resolving [3], conventional medical practice leans towards prescribing broad-spectrum antibiotics to hasten recovery, mitigate complications, curb pathogen spread, and alleviate discomfort [4]. Antibiotics are also employed in viral conjunctivitis cases to forestall secondary bacterial infections. However, escalating microbial resistance [5,6], exorbitant costs, and adverse effects of antibiotics underscore the urgency for alternative treatment modalities in infectious conditions.

Ayurvedic literature enumerates several topical ophthalmic formulations for addressing *Abhishyanda*. In this study, we scrutinized one such formulation delineated in the Sharangdhara Samhita, featuring *Nimba* (*Azadirachta indica* Juss.) and *Lodhra* (*Symplocos racemosa* Roxb.) as constituents [7], to assess its efficacy in combating infective conjunctivitis. Levofloxacin 0.5% eye drops, a mainstream treatment for infective conjunctivitis [8], served as the control group.

The study encompassed three clinical scenarios: acute mucopurulent conjunctivitis, acute hemorrhagic conjunctivitis, and acute hemorrhagic conjunctivitis with mucopurulent discharge. Diagnoses were solely based on clinical manifestations, with bacterial involvement inferred from the presence of mucopurulent discharge. Viral conjunctivitis diagnoses stemmed from cases occurring amidst an epidemic of hemorrhagic conjunctivitis during the study period, exhibiting typical viral conjunctivitis features.

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METHODS

This prospective, randomized, single-blind, drug-controlled clinical trial was conducted at the Institute of Medical Sciences (IMS), Banaras Hindu University (BHU), Varanasi, India. The study received clearance from the Ethical Committee of IMS, BHU, Varanasi, India, and was registered with the Clinical Trial Registry India (CTRI/2017/06/008746).

The trial involved 60 eyes of 30 patients, who were randomly assigned to two groups using a computer-generated random number sequence. Group I, also known as the Nimbadi Group (Trial Group), and Group II, referred to as the Levofloxacin Group (Control Group), each comprised 30 eyes (equating to 15 patients), receiving 2 drops of the respective drug four times daily for 10 days. Both eyes drop formulations were dispensed on day 0, and patients returned to the outpatient department (OPD) for interim assessments on day 2 and day 5, as well as a final visit on day 10, during which all required examinations were repeated. Additionally, blood investigations were conducted to assess parameters including hemoglobin percentage, total leukocyte count, differential leukocyte count, and erythrocyte sedimentation rate.

Preparation of Eye Drops

Fresh *Nimba* leaves were harvested from the vicinity of the hospital, while *Lodhra* bark was procured from the market. The authenticity of both botanicals was verified by an expert from the Department of Dravyaguna, Faculty of Ayurveda, BHU, Varanasi, India.

The formulation process involved modifications to the traditional Ayurvedic method known as *Putpaka* [7]. First, *Lodhra* bark was cleaned, dried, and ground into powder using a grinder. *Nimba* leaves were washed and transformed into a paste using an electric mixer. Separately, *Lodhra* powder was mixed with distilled water to form a paste. The pastes of both ingredients were then amalgamated into a bolus and layered according to the technique outlined in the Sharangdhar Samhita. This composite was subjected to heating in an oven at 100°C for one hour. Subsequently, the layer was separated from the bolus, and the liquid content was obtained through straining and filtration using a fine cloth. The resulting brownish-green liquid was then centrifuged at 10,000 rpm for 30 minutes, yielding a clear brownish filtrate with a pH of 6.5. This filtrate underwent sterilization via autoclaving before being dispensed into 5 ml sterile containers under aseptic conditions. The prepared solution was stored in a refrigerator prior to distribution to patients, and no preservatives were added.

Microbiological assessment of the trial drug was conducted in the Department of Microbiology to monitor for microbial growth immediately after preparation, after 10 days, and after 45 days of preparation and packaging.

Inclusion Criteria

Patients were inclusively selected regardless of gender, religion, or occupation. The inclusion criteria comprised individuals aged at least 12 years who exhibited a clinical diagnosis of infective conjunctivitis in at least one eye. Only patients who willingly provided informed consent were enrolled in the study.

Exclusion Criteria

Patients presenting with concurrent eye conditions that could potentially confound the assessment of infective conjunctivitis (*Netrabhishyanda*), such as anterior uveitis, scleritis, episcleritis, were excluded from the study. Additionally, measures were in place to exclude patients in the event of complication development during the course of the study.

Diagnosis and Assessment

At baseline (day 0), demographic data and comprehensive medical histories were obtained from each patient, coupled with systemic examinations to rule out any concurrent diseases affecting other bodily systems. The severity of ocular symptoms and signs was meticulously evaluated through a combination of historical inquiry, gross examination, slit-lamp biomicroscopy, assessment of best-corrected visual acuity (BCVA), and fundus examination.

Diagnostic criteria were established based on the symptomatic presentation and observable signs of the disease. Ayurvedic diagnosis relied on identifying symptoms of *Netrabhishyanda* such as *Daaha* (burning sensation), *Ushnaashrutaa* (warm lacrimal secretions), *Kandu* (itching), alongside signs like *Prapaaka* (suppuration), *Lohitanetrataa* (redness of the eye), *Rajyaasamntaata atilohitashcha* (congestion and/or hemorrhage), *Shopha* (edema), and others [2]. Modern diagnostic criteria encompassed symptoms and signs such as conjunctival discharge, bulbar conjunctival injection, palpebral conjunctival injection, itching, watering, grittiness, foreign body sensation, eyelid edema, eye pain, visual blurring, photophobia, burning or stinging sensation, discomfort, subconjunctival hemorrhage, and lymphadenopathy.

A total of 30 patients were recruited and enrolled, subsequently randomized into two groups: Group I, designated as the Trial Group (Nimbadi Group), and Group II, designated as the Control Group (Levofloxacin Group). Each group consisted of 30 eyes (equating to 15 patients), receiving 2 drops of the assigned medication four times daily for 10 days. The medications, Nimbadi eye drops, and Levofloxacin 0.5% ophthalmic solution were dispensed on day 0, and patients returned to the outpatient department (OPD) for interim assessments on day 2 and day 5, as well as a final visit on day 10, during which the aforementioned examinations were repeated. Furthermore, blood investigations were conducted to assess parameters including hemoglobin percentage, total leukocyte count, differential leukocyte count, and erythrocyte sedimentation rate. The grading criteria utilized to evaluate ocular features were delineated in Tables 1, 2, and 3.

Table 1: Rating Scale For Assessment Of Conjunctival Discharge, Bulbar Conjunctival Injection And Palpebral Conjunctival Injection

Score	Conjunctival Discharge	Bulbar Conjunctival injection	Palpebral Conjunctival injection
0	No discharge	Normal conjunctival vascular patterns	Normal upper tarsal papillary response
1	Small amount of discharge collection in the inner canthus	Localized, mild vascular injection	Diffuse follicular pattern (small follicles) or discrete fine papillary reaction with mild hyperaemia without obscuring underlying details
2	Small amount of discharge in the lower cul-de-sac	Diffuse, mild vascular injection	Features of grade 1 including mild conjunctival edema
3	Moderate amount of discharge in the lower cul-de-sac without matting together of eyelids upon awakening in the morning	Diffuse, moderate vascular injection, obvious from a distance, usually with minimal sub-conjunctival haemorrhages	Diffuse follicular reaction (large follicles) or diffuse confluent papillary response, moderate hyperaemia but without haemorrhage
4	Moderate amount of discharge in the lower cul-de-sac with matting together of eyelids upon awakening in the morning	Diffuse hyperaemia that is obvious from a distance and may have scattered petechiae associated subconjunctival haemorrhages	Diffuse follicular reaction (large follicles) or diffuse confluent papillary response, pronounced hyperaemia with haemorrhage and blurring of underlying details
5	Profuse mucopurulent or purulent discharge in the lower cul-de-sac and marginal tear strip. Eyelids tightly matted together upon arising in the morning, requiring warm soaks to separate lids.	'Beet' red eye that may have subconjunctival haemorrhages present in significant numbers and sizes	Marked inflammatory changes in the subconjunctival tissue with evidence of epithelial necrosis and the upper tarsal papillary response completely obscures underlying details

Table 2: Rating Scale For Assessment Of Symptoms

Score	Watering	Photophobia	Burning/Stinging Sensation, Foreign Body Sensation, Grittiness, Itching and Ocular Discomfort	Eye-Pain (Visual Analogue Scale grading)
0 (Normal)	No watering	No light sensitivity	Absent	0
1 (Mild)	Increased tear film meniscus, occasionally tears flow out of eyes	Can work outdoors with slight discomfort	Present but not distressing	1-3
2 (Moderate)	Outflow of tears several times a day on exposure to wind or doing some work	Can work in daylight with moderate discomfort	Distressing but not interfering with daily life	4-6
3 (Severe)	Outflow of tears most of the time in a day requiring frequent moping	Can open eyes with difficulty in light	Very distressing and interferes with daily life	7-10

Table 3: Rating Scale For Assessment Of Eyelid-Edema, Visual Blurring And Lymphadenopathy

Score	Eyelid-edema, Visual Blurring and Lymphadenopathy
2	Not improved
1	Improved
0	Cured

Statistical Analysis

Non-parametric statistical methods were employed for data analysis. Treatment groups were compared for signs such as conjunctival discharge, bulbar conjunctival injection, palpebral conjunctival injection, subconjunctival hemorrhage, eyelid edema, and lymphadenopathy using the Mann-Whitney Test. Symptoms including itching, burning sensation, watering, grittiness, ocular discomfort, foreign body sensation, blurring of vision, photophobia, and pain were compared using Fisher's Exact Test, assessing the change in scores from baseline on day 2, day 5, and day 10.

Intragroup comparisons were conducted using the Wilcoxon Signed Ranks Test for signs and the Friedman Chi-square Test for symptoms. These analyses were utilized to evaluate the efficacy of treatment interventions over time within each group.

RESULTS

The study revealed that there were no statistically significant differences in demographic characteristics and medical histories between the two groups ($p > 0.05$) (Table 4). Among the patients, 56.67% (17 patients, 34 eyes) were diagnosed with acute hemorrhagic conjunctivitis with mucopurulent discharge, 26.66% (8 patients, 16 eyes) had acute mucopurulent conjunctivitis, and only 16.67% (5 patients, 10 eyes) presented with acute hemorrhagic conjunctivitis. It was noted that bulbar conjunctival injection and palpebral conjunctival injection were present in all cases, with conjunctival discharge observed in 91.67% (55) of eyes. Symptoms such as burning sensation, discomfort, and foreign body sensation were reported in 86.67% (52) of eyes, while watering was noted in 83.33% (50) of eyes. Itching, grittiness, subconjunctival hemorrhage, lid edema, pain, photophobia, and visual blurring were complained of by 76.67% (46), 76.67% (46), 73.33% (44), 71.67% (43), 66.67% (40), 60% (36), and 48.33% (29) of eyes, respectively. Only 5 patients out of 30 (16.67%) had lymphadenopathy.

The treatment responses in both groups were recorded based on the clinical manifestations after 2 days, 5 days, and 10 days of treatment. With both *Nimbadi* eye drops and Levofloxacin (0.5%) eye drops treatments, the mean scores for all signs and symptoms were reduced at each visit (day 2, day 5, and day 10) compared to baseline values (day 0) (Table 5). The difference was highly significant ($p < 0.001$)

between day 0 and day 10 of the visit for all signs and symptoms in both groups. The intergroup comparison demonstrated that both treatment groups were equally effective and statistically similar in alleviating bulbar conjunctival injection, palpebral conjunctival injection, subconjunctival hemorrhage, itching, burning sensation, watering, foreign body sensation, and grittiness. There was a statistically significant improvement ($p< 0.05$) in mean scores in discharge on day 2 and day 5, and discomfort on day 5 and day 10 in the Trial Group compared to the Control Group, indicating better efficacy of *Nimbadi* eye drops on conjunctival discharge and ocular discomfort (Figure 1 and Figure 2). By day 10, photophobia was completely relieved by the Trial drug. However, Levofloxacin eye drops showed better improvement in pain and lid edema on day 2 and day 5, respectively. The mean score of lymphadenopathy was similar on day 0 and day 2 in both groups. On day 5, there was an improvement in the mean score in both groups, but on day 10, it remained the same as it was on day 5. Overall improvement was not statistically significant either within the groups or between the group comparisons. No significant changes were observed in hemoglobin percentage, total leukocyte count, differential leukocyte count, and erythrocyte sedimentation rate in any of the groups.

Table 4: Patient Demographics

Variable		Group I	Group II
Age	Range (in years)	10-50	10-50
	Mean±SD	28.73±11.50	27.80±8.97
Sex	Male	10 (66.67%)	10 (66.67%)
	Female	05 (33.33%)	05 (33.33%)
Religion	Hindu	14 (93.33%)	14 (93.33%)
	Muslim	01 (6.66%)	01 (6.66%)
Occupation	Student (maximum)	07 (46.66%)	08 (53.33%)
Marital Status	Married	08 (53.33%)	07 (46.67%)
	Unmarried	07 (46.67%)	08 (53.33%)
Habitat	Rural	04 (26.67%)	06 (40%)
	Urban	11 (73.33%)	09 (60%)
Educational status	Graduate (maximum)	06 (40%)	07 (46.67%)
Economic status	Middle class (maximum)	09 (60%)	07 (46.67%)
Dietary habits	Vegetarian	06 (40%)	07 (46.67%)
	Non-vegetarian	09 (60%)	08 (53.33%)
Addiction	None (maximum)	09 (60%)	08 (53.33%)
Deha-Prakriti	*Pitta-Kapha* (maximum)	11 (73.33%)	09 (60%)

Table 5: Clinical Assessment Of Ocular Signs And Symptoms At Day 2 And Day 5 Of Trial Treatment Period: Intergroup Comparison Of Change In Mean Of Severity Score

		Mean change from baseline		
Signs/Symptoms	**Baseline (Mean score)**	**Day 2**	**Day 5**	**Day 10**
Conjunctival discharge				
Nimbadi E/D	2.93	-1.23	-2.3	-2.93
Levofloxacin E/D	2.57	-0.77	-1.53	-2.57
*Statistical significance of treatment difference**	*p>0.05*	*p=0.012*	*p=0.012*	*p>0.05*
Bulbar conjunctival injection				
Nimbadi E/D	3.9	-1.1	-2.13	-3.73
Levofloxacin E/D	3.63	-1.23	2.27	3.5
*Statistical significance of treatment difference**	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Palpebral conjunctival injection				
Nimbadi E/D	3.47	-1.07	-2.03	-3.3
Levofloxacin E/D	3.57	-1.13	-2.17	3.43
*Statistical significance of treatment difference**	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Sub-conjunctival haemorrhage				
Nimbadi E/D	1.8	-0.67	-1.1	-1.4
Levofloxacin E/D	2.17	-0.53	-1.13	1.63
*Statistical significance of treatment difference**	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Itching				
Nimbadi E/D	1.93	-0.67	-1.3	-1.8
Levofloxacin E/D	1.97	-0.53	-1.13	-1.8
*Statistical significance of treatment difference***	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Burning sensation				
Nimbadi E/D	1.83	-0.13	-1.5	1.77
Levofloxacin E/D	2.17	0.37	1.37	2.07
*Statistical significance of treatment difference***	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*

Watering				
Nimbadi E/D	2.1	-0.77	-1.37	-1.97
Levofloxacin E/D	1.93	-0.67	-1.23	-1.77
*Statistical significance of treatment difference***	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Ocular discomfort				
Nimbadi E/D	2.1	-0.7	-1.47	-1.97
Levofloxacin E/D	1.73	-0.73	-1.43	-1.53
*Statistical significance of treatment difference***	*p=0.028*	*p>0.05*	*p=0.042*	*p=0.030*
Foreign body sensation				
Nimbadi E/D	1.53	-0.5	-1.03	-1.47
Levofloxacin E/D	1.67	-0.53	-1.13	-1.53
*Statistical significance of treatment difference***	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Grittiness				
Nimbadi E/D	1.8	-0.48	-1.33	-1.67
Levofloxacin E/D	1.83	-0.7	-1.4	1.67
*Statistical significance of treatment difference***	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Blurring of vision				
Nimbadi E/D	0.87	-0.5	-0.73	-0.87
Levofloxacin E/D	1.07	-0.67	-0.9	-1.07
*Statistical significance of treatment difference***	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Photophobia				
Nimbadi E/D	0.93	-0.47	-0.8	-0.93
Levofloxacin E/D	0.93	-0.27	-0.77	-0.8
*Statistical significance of treatment difference***	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*
Lid-edema				
Nimbadi E/D	1.27	-0.63	-0.67	-1.13
Levofloxacin E/D	1.6	-0.8	-1.3	-1.33
*Statistical significance of treatment difference**	*p>0.05*	*p>0.05*	*p=0.001*	*p>0.05*
Pain				
Nimbadi E/D	0.97	-0.4	-0.83	-0.97
Levofloxacin E/D	1.17	-0.77	-1.03	-1.17
*Statistical significance of treatment difference***	*p>0.05*	*p=0.008*	*p>0.05*	*p>0.05*
Lymphadenopathy				
Nimbadi E/D	0.4	0	-0.2	-0.2
Levofloxacin E/D	0.27	0	-0.13	-0.13
*Statistical significance of treatment difference**	*p>0.05*	*p>0.05*	*p>0.05*	*p>0.05*

* Mann-Whitney Test; ** Fisher's Exact Test; E/D = Eye drops

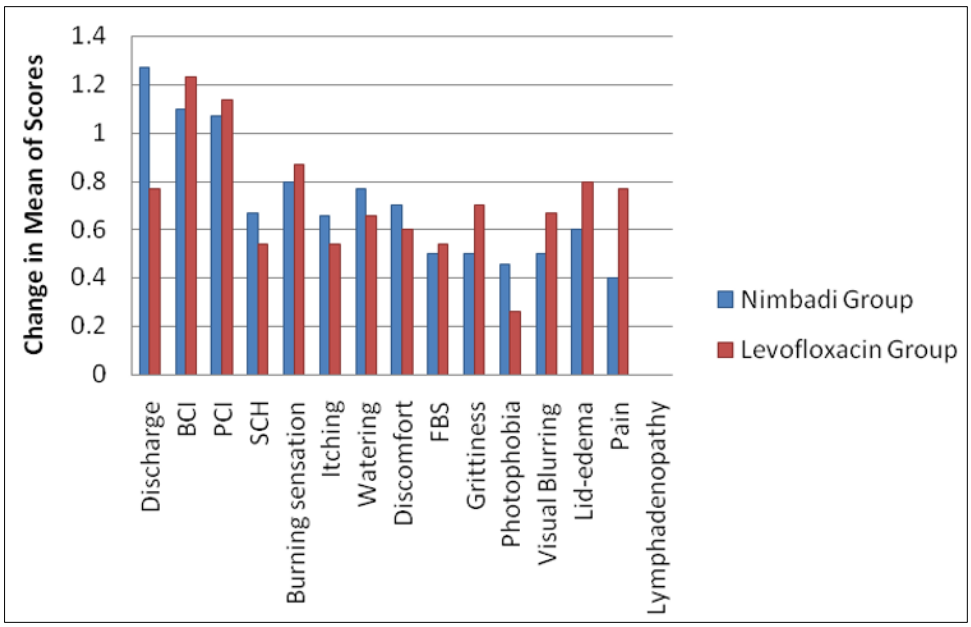

Figure 1: Improvement in Mean Score of Signs and Symptoms from baseline on Day 2

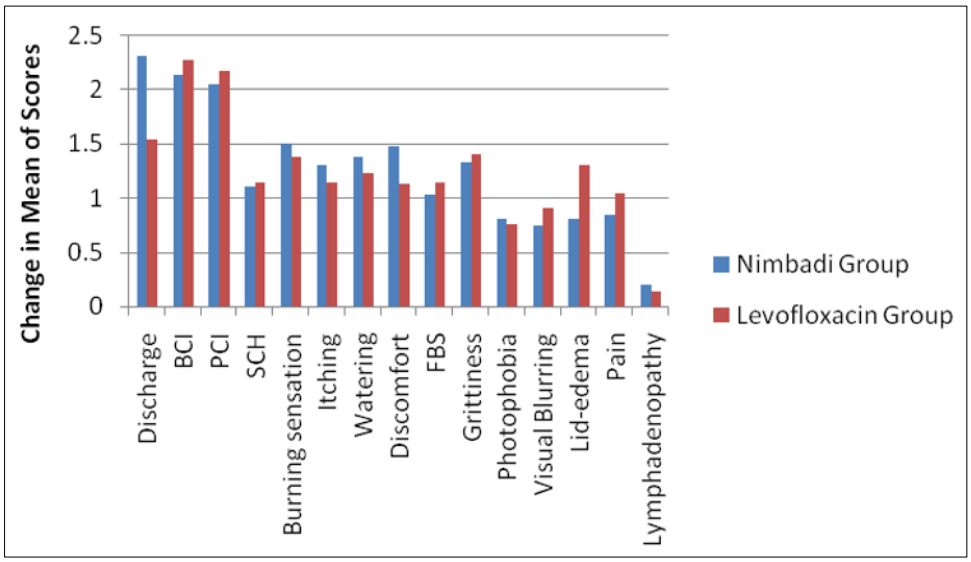

Figure 2: Improvement in Mean Score of Signs and Symptoms from baseline on Day 5

DISCUSSION

The clinical diagnosis of the patients included in the study encompassed acute mucopurulent conjunctivitis and epidemic hemorrhagic viral conjunctivitis, characterized by watery or mucopurulent discharge. Ayurvedic diagnostic methods relied heavily on clinical manifestations. Features such as redness, burning sensation, watery or mucopurulent discharge, and edema suggested the involvement of vitiated *Rakta* and *Pitta* in the disease process. This aligns with Ayurvedic principles where manifestations such as purulent discharge (*Prapaka*), congestion (*Lohitanetrata*), hemorrhage (*Rajyaasamntata atilohitashcha*), and burning sensation (*Daha*) are attributed to vitiated *Rakta* and *Pitta doshas* [2]. Additionally, features like mucoid discharge (*Pichhila srava*), itching (*Kandu*), heaviness (*Gurutaa*), and edema (*Shopha*) are indicative of vitiated *Kapha* [2]. While all three *doshas* were present in the infective conjunctivitis cases studied, the dominance of *Rakta* and *Pitta doshas* was noted, indicating a *tridoshaja abhishyanda* with a preponderance of *Rakta* and *Pitta doshas*.

Both *Nimba* and *Lodhra* possess properties that alleviate vitiated *Rakta*, *Pitta*, and *Kapha doshas*. Hence, the present study aimed to assess the clinical efficacy of *Nimbadi* eye drops in comparison to Levofloxacin 0.5%, a broad-spectrum antibiotic commonly prescribed for infective conjunctivitis. This formulation was chosen based on the clinical presentation of the disease, the involvement of vitiated *doshas*, and the anti-infective, anti-inflammatory, decongestant, immunomodulatory, abhishyandhara [7] and *Pitta* and *Rakta* alleviating properties of the constituent drugs.

Given that acute infective conjunctivitis typically resolves within a short duration, the trial drug was prescribed for a brief period of 10 days. Microbial analysis of the prepared drug indicated the absence of contamination for at least 45 days, obviating the need for preservatives during this period. Furthermore, the drug exhibited no adverse effects even after 10 days of use, underscoring its safety profile for topical application as eye drops.

The trial drug demonstrated superior efficacy in controlling discharge and discomfort compared to the control drug. By day 10, there was no statistically significant difference in all features between the two groups, except for discomfort, likely due to the near-complete resolution of symptoms and signs in both groups. The reduction in discharge suggests effective control of the infection. Both the trial drug and control drug were equally effective in controlling bulbar conjunctival injection, palpebral conjunctival injection, subconjunctival hemorrhage, itching, burning sensation, watering, foreign body sensation, grittiness, and pain, indicating comparable efficacy between the two treatments. Notably, photophobia was completely relieved by the trial drug by the final visit (day 10). Lymphadenopathy, a systemic feature of viral conjunctivitis, was observed in very few patients, and although improvement was noted in both groups, the difference was not statistically significant, likely due to the slow recovery of this symptom.

Relief in clinical features was attributed to the reduction in inflammation. Both drugs were almost equally effective in controlling most clinical features, with only a few exceptions where one drug exhibited slightly superior efficacy. Existing literature on *Nimba* and *Lodhra* suggests multiple mechanisms, either independently or in combination, may influence the inflammatory process directly or indirectly.

The *Nimbadi* eye drops comprise two key ingredients: *Nimba* (*Azadirachta indica* Juss.) and *Lodhra* (*Symplocos racemose* Roxb.). Nimba possesses several important properties or "Gunas" according to Ayurveda, including *laghu* (lightness) and *ruksha* (dryness). It also has a *tikta* (bitter) taste, *katu* (pungent) *vipaka* (taste conversion after digestion), and *sheet virya* (coolness potency) [9]. These properties contribute to Nimba's therapeutic effects. From an Ayurvedic perspective, *Nimba* acts primarily through its *tikta rasa* (bitter taste), which serves to alleviate itching and destroy parasites or *krimi*. *Nimba* is also noted for its *vishaghna* properties, meaning it acts as a detoxifier, and *dahashamaka* properties, which help relieve burning sensations. Additionally, *Nimba* possesses *kledahara* properties, which decrease moisture, and *puyashoshaka* properties, which aid in drying up pus [10]. Furthermore, *Nimba* has *pitta-kaphashamaka* properties,

meaning it helps balance *Pitta* and *Kapha doshas*, according to Ayurvedic principles. The *ruksha guna* (dryness property) of *Nimba* contributes to its *shoshana* property [11], which aids in absorption and drying. Its *laghu guna* (lightness property) is known for its *shrotoshodhaka* effect [11], meaning it purifies the body channels. Additionally, *Nimba's sheeta virya* (cool potency) possesses *stambhana* (to stop) and *prasadana* (soothing) effects [12], contributing to its ability to alleviate symptoms and promote comfort. Nimba is also considered a *sukshma dravya*, meaning it is a subtle substance that permeates the microstructures of the body due to its *sukshma* (subtle) property [13]. This characteristic enables *Nimba* to exert its effects at a deep level within the body according to Ayurvedic principles. Indeed, *Nimba's* properties make it well-suited for alleviating diseases caused by imbalances in *Kapha* and *Pitta doshas* according to Ayurvedic principles. In Charaka Samhita, *Nimba* is categorized within the *Kandughna Mahakashaya*, a group of herbs known for their ability to relieve itching [14]. Additionally, *Nimba* is classified under the *Tikta-skandha* group, which comprises bitter substances [15]. Bitter herbs like *Nimba* are traditionally used in Ayurveda to address imbalances in *Rakta dosha*.

Lodhra (*Symplocos racemosa*) is characterized by specific Ayurvedic properties, including *laghu* (lightness) and *ruksha* (dryness) *Gunas*, *kashaya* (astringent) *Rasa*, *katu* (pungent) *Vipaka*, and *sheeta* (coolness) *Virya* [16]. Medicinal substances possessing these attributes are traditionally employed in treating disorders stemming from imbalances in *Kapha* and *Pitta doshas*. The *kashaya rasa*, in particular, exhibits multiple therapeutic actions, including *sanshamana* (alleviating effect on *doshas*), *samgrahi* (absorbing), *vrana-ropana* (wound healing), *shoshana* (moisture drying), *stambhana* (arresting), and *Kapha-Rakta-Pitta* alleviating properties [17]. Its efficacy extends to addressing hemorrhagic conditions owing to its astringent nature.

A thorough literature review reveals that multiple mechanisms, whether acting independently or synergistically, can impact inflammatory processes both directly and indirectly. *Nimba* leaf preparations contain potent compounds such as Nimbidin and Azadirachtin, which exhibit a broad spectrum of pharmacological activities including anti-inflammatory, antibacterial, antifungal, and antiviral effects against various pathogens [18-25]. These compounds not only inhibit TNF-induced biological responses but also bolster the immune system, contributing to their therapeutic efficacy [26]. Similarly, *Lodhra* bark harbors a range of beneficial properties attributable to its diverse array of active molecules such as symplocosides, symposides, and loturine. These bioactive constituents confer analgesic, anti-inflammatory, antibacterial, antioxidant, and immunomodulatory properties to Lodhra, underscoring its potential as a versatile therapeutic agent [27-32].

CONCLUSION

The *Nimbadi* eye drops consist of a synergistic combination of ingredients that harbor properties aimed at halting or mitigating the advancement of infective conjunctivitis. The collective impact of the drug is on par with that of Levofloxacin 0.5%. Hence, it can be inferred that the trial drug is as effective as the control drug in delivering symptomatic relief and managing the progression of the disease.

Conflict of interest

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